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NATIONAL BUREAU OF STANDARDS

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COVER: *Discontinuities in a porcelain enameled specimen are seen as bright spots in this time-elapsed photograph. The spots record arcing as M. A. Baker passes a high-voltage probe over the specimen.* *(See page 38.)*

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The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:

- The Institute for Basic Standards
- The Institute for Materials Research
- The Institute for Applied Technology
- Center for Radiation Research
- Center for Computer Sciences and Technology

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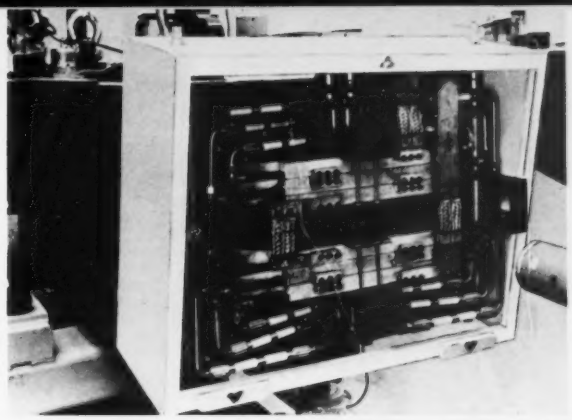
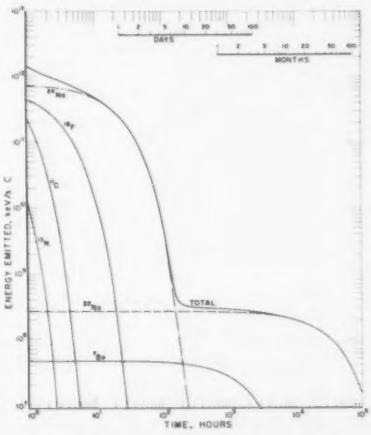
Data Assists Design of

PARTICLE ACCELERATORS



Above: Such complicated apparatus as this bending magnet of the Stanford Linear Accelerator become radioactive while in operation. (Courtesy of Stanford Linear Accelerator Center.) Below: Use of this graph will identify the radioactive materials present in accelerator parts.



THE BEAMS OF HIGH-ENERGY particle accelerators transform many accelerator components into radioactive materials, creating health physics problems. James M. Wyckoff of the NBS Center for Radiation Research has obtained radioactivity data from analysis [1] of metals bombarded with electrons in the 3 to 13 GeV range. Earlier experiments [2, 3] were performed in the 100 and 300 MeV range using electron and positron beams. Mr. Wyckoff not only obtained very basic information on the effects of high energy radiation, but he also applied his efforts to the field of health physics. His data provide scientists with knowledge of the probable types and quantities of radioactive spallation products of accelerator parts following accelerator operations. Such information can be applied to the problem of determining the best method of handling the radioactive parts.

During accelerator operation, particles, for example electrons, do not all travel the same well-defined path. Some electrons strike the walls of the accelerator, some penetrate surrounding magnets and instruments, and some pass right through the equipment and into heavy shielding surrounding the instrument. As the electrons, and resulting photons, pass through the various construction materials, they interact with atoms, producing radioactive spallation products. Some of these products lose their activity quickly, others slowly. The decay rate is usually expressed in terms of half-life, the time required for the level of activity to fall to one half its original level.

Mr. Wyckoff irradiated many materials with high energy electrons at the Stanford Linear Accelerator Center (SLAC). Included in the study were aluminum, copper, indium, iron, lead, molybdenum, nickel, and tantalum. Thin sheets of these metals were interleaved into several packets, with aluminum at both ends of a packet to measure activity buildup resulting from cascade processes. The packets were irradiated with electrons having energies of 5, 10, 13.3, or 16 GeV. While at SLAC Mr. Wyckoff determined the quantities of the fast decaying spallation products in his samples. Other long-lived products were analyzed by C. B. Fulmer, I. R. Williams, and E. L. Callis at the Oak Ridge National Laboratory.[4]

Each of the materials studied produces many different radioactive spallation products. For example aluminum, when irradiated with a 13.3 GeV electron beam, produces such radioactive nuclides as beryllium-7, carbon-11, fluorine-18, nitrogen-13, sodium-22, and sodium-24. Of these, nitrogen, carbon, fluorine, and sodium-24 nuclides all have high initial intensities but short half-lives (1 to 15 hours). In comparison, sodium-22 and beryllium-7 have low initial intensities but long half-lives (1000 to 100 000 hours).

Scientists at the Brookhaven National Laboratory performed similar experiments [5] using 3 to 30 GeV proton beams. Comparison of the spallation products produced by protons with those produced in the same materials by electrons showed close similarities. Although proton irradiations produced greater amounts of each spallation product, few differences were observed between the types and relative intensities of the spallation products formed. This indicates that health physics problems of both electron and proton accelerators will be aided by the present study.

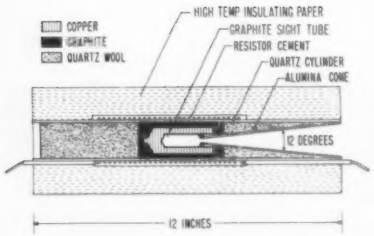
[1] Wyckoff, J. M., Photon energy emission from spallation products produced by 3 to 13 GeV electrons, Health Phys. (to be published).

[2] Wyckoff, J. M., Radioactivity produced by a linac, IEEE Trans. Nucl. Sci. NS-14, 990 (June 1967).

[3] Halpern, I., Debs, R. J., Eisinger, J. T., Fairhall, A. W., and Richter, H. G., Yields of photonuclear reactions with 320-MeV x-rays. II. Interpretation of results, Phys. Rev. 97, No. 5, 1327–1336 (Mar. 1955).

[4] Further analyses of this work will be published at a later date.

[5] Hudis, J., Dostrovsky, I., Friedlander, G., Grover, J. R., Porile, N. T., Remsberg, L. P., Stoenner, R. W., and Tanaka, S., Energy dependence of product yields in copper spallation by protons between 3 and 30 GeV, Phys. Rev. 129, No. 1, 434–437 (Jan. 1963).



Above: Cross-sectional drawing of the NBS developed copper-point blackbody that realizes the radiance temperature of 1083.3 °C with an uncertainty of 0.2 °C. Right: R. D. Lee assembles the simple, inexpensive high-precision blackbody developed at NBS.

SIMPLE, INEXPENSIVE COPPER-POINT BLACKBODY AND FURNACE

A SIMPLE, INEXPENSIVE COPPER-POINT blackbody-furnace has been devised [1] by R. D. Lee of the NBS Institute for Basic Standards. The apparatus provides a source of radiance temperature having an uncertainty of 0.2 °C at 1083.3 °C and a variation in successive use of less than 0.033 °C. The blackbody-furnace is useful for monitoring the low-range, long-term stability of automatic and visual optical pyrometers and should also be useful for various radiometric purposes. It has a maximum exit cone of over 12 degrees (full angle) and an aperture or target of about 3.5 mm diameter. The emissivity has been determined to be over 0.999.

The furnace requires no inert gas or vacuum and utilizes only 225 watts to reach a melt in about an hour after turn on. Melts and freezes last about five minutes each (longer melts and freezes are possible with power adjustments) and at least fifty melts and freezes can be expected during the lifetime of the furnace.

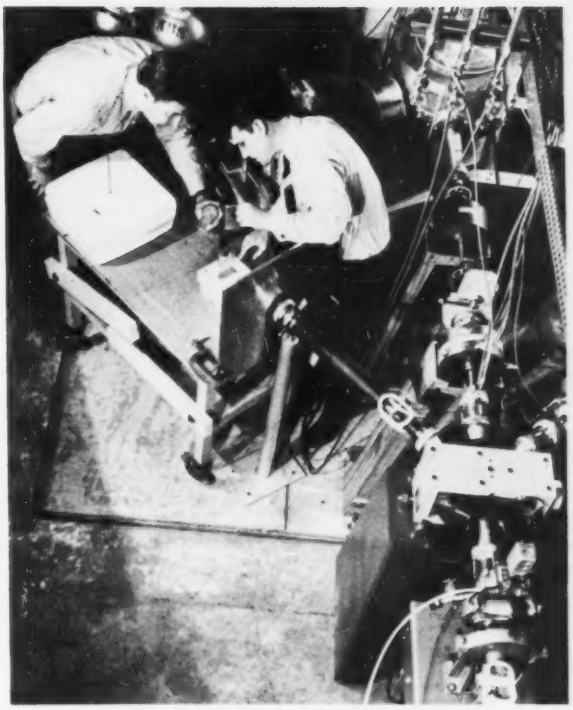
The blackbody-furnace consists mainly of an alumina cone, quartz cylinder, graphite crucible, sight tube, a copper ingot [2] standard reference material, heater windings, and high-temperature insulating paper. The materials may be expected to cost between $100 and $150.

Besides furnaces of this design, a furnace was made of commercially available heating elements with the windings embedded in semi-cylinders. The graphite crucible, however, soon burned apart due to inadequate protection. In another furnace a mullite cylinder and mullite cone were used. The difference in performance of these various designs was insignificant, indicating that the performance of the described furnace is not critically dependent on workmanship or source of materials.

[1] For complete construction details, see Lee, R. D., **Construction and Operation of a Simple High-Precision Copper-Point Blackbody and Furnace**, Nat. Bur. Stand. (U.S.), Tech. Note 483 (May 1969).

[2] For a complete list of NBS Standard Reference Materials, see **Standard Reference Materials: Catalog and Price List of Standard Materials Issued by the National Bureau of Standards**, Nat. Bur. Stand. (U.S.), Spec. Publ. 260 (July 1, 1969 ed.). For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for 50 cents.

RADIOCHROMIC DYES USED TO LOOK AT RADIATION BEAMS



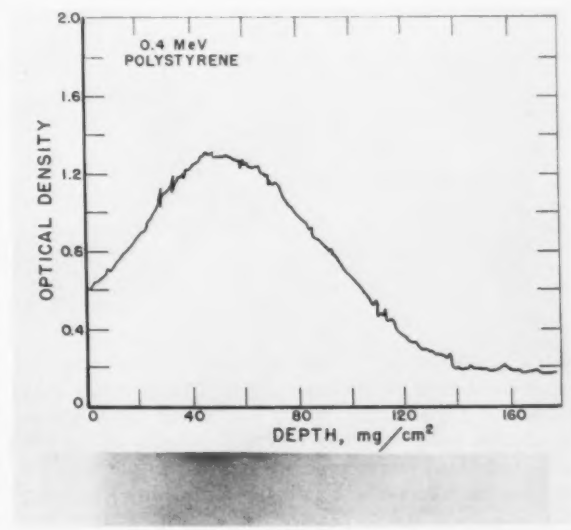
As William L. McLaughlin watches, Echart K. Hussmann (right) inserts film to be irradiated between two carbon disk calorimeters.

SOME RADIOCHROMIC DYE PRECURSORS, initially colorless, acquire a characteristic color when subjected to radiation. The gradual formation of color is caused by molecular reorientation resulting from bonds polarized by absorbed radiation. Physicists at the Bureau have developed a radiation measurement procedure employing dye films and gels that provides a simple and relatively accurate calibration of radiation beams and measurement of radiation dose distributions. These dosimeters are expected to benefit users of industrial radiation processing of materials, chemicals, foodstuffs, and medical supplies.

The procedure [1] for using triphenylmethane dye cyanides in radiation research studies is based on earlier ultraviolet imaging techniques of Lyman Chalkey,[2] and was developed by W. L. McLaughlin of the NBS Center for Radiation Research and E. K. Hussmann, a guest worker at the Center, on a NATO Fellowship from the Max-Planck Institut für Biophysik, Frankfurt, Germany. Support for the project was provided by AEC's Division of Isotopes Development. As a result of this work, dye films and papers may be used as dosimeters in research using radiation beams, or the dyes may be incorporated into gels or porous materials, as for example into materials simulating body tissue for medical studies. Liquid solutions of dyes have not been studied.

Radiochromic dye cyanide solid solutions, such as "pararosaniline" or "new fuchsin" dye precursors, are well suited for radiation measurements. The responses of these materials per unit energy absorbed is nearly the same under varying conditions of radiation (10 keV to 10 MeV electrons or x rays), temperature (193 to 370 K), and atmosphere (air or vacuum). The response range is 10^2 to 10^8 rads (1 rad$=10^{-2}$ J/kg), depending on such parameters as the geometry of the system and the type of dye solution being irradiated. Three ideal matrix substances for making thin cyanide film samples are photographic gelatin, nylon, and absorptive paper. Some of the solvents used in producing dye gels include gelatin, aromatic amines or carbinols, hydrocolloids, acid esters, cellulose, polymides and other polymeric activators.

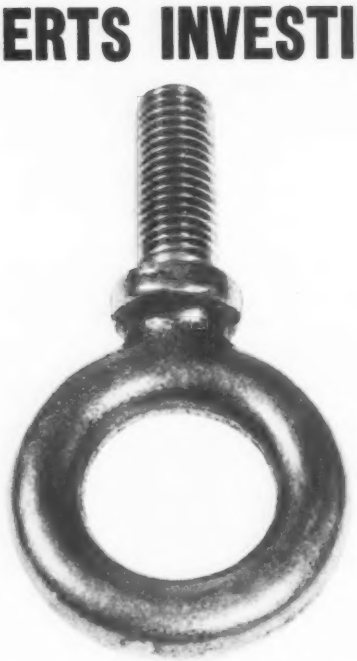
Industrial x-ray machines, cobalt-60 and cesium-137 gamma-ray sources, and several electron accelerators were used for test irradiations. Intercomparison of samples with



Density is plotted as a function of the depth of penetration of 0.4 MeV electrons in polystyrene—peaks indicate points of greater intensity. Below: A strip of film shows the density changes—darker spots on the film correspond to peaks on graph.

(Continued p. 38)

CONCRETE EMBEDDED INSERTS INVESTIGATED



Three types of inserts for ¾-inch bolts tested in a study to determine the variables involved in the load-carrying capacity of concrete-embedded inserts.

WITH CONSTRUCTION COSTS increasing daily, more and more equipment normally occupying floor space is being suspended from ceilings to minimize floor-space requirements. Obviously, the load-carrying capacity of the concrete embedded inserts generally used for suspension is of importance for occupant safety and structure durability. No systematic study, however, is known to have been carried out on the factors that affect the load-carrying capacity of inserts in reinforced concrete slabs.

To supply these data, the NBS Institute for Applied Technology, under sponsorship of the Post Office Department, conducted a comprehensive study of the variables influencing the ultimate load-carrying capacity of various commonly used inserts.[1] The objective of this investigation, by T. W. Reichard, E. F. Carpenter, and E. V. Leyendecker of the NBS Building Research Division, was to obtain information that may lead to design criteria.

In the study, three different types of inserts for ¾-in threaded bolts were used. Type 1 was a malleable iron insert, especially designed for use where impact or vibration is a factor. Type 2 insert was spool shaped with a loop of 0.26-in diameter steel wire welded to the spool. It was

machined from mild steel. Type 3 insert was also made from malleable iron but of different shape than type 1. All the inserts are nailed to the form prior to pouring the concretes.

Two normal weight concretes and five lightweight aggregate concretes were used in this study. Most of the concretes were obtained from a ready-mix contractor.

Approximately 400 concrete slabs with embedded inserts were tested at various ages, ranging from 5 to 35 days after pouring. Ninety percent of these were 42 in × 45 in × 4½ in specimens with a single insert in their centers. Other specimens were 42 in × 22 ft × 4½ in and 45 in × 15 ft 9 in × 4½ in. Up to 19 inserts were placed in the longer slabs.

The specimens were subjected to static, sustained, and fatigue loading tests.

In the static tests, a tensile pull-out load was applied to the insert at a uniform rate until failure occurred. The maximum load attained during the tests was considered the pull-out load of the insert. A standard loading rate of 2000 lbs (1 lb = 4.5 N) per minute was used for the static tests.

Static flexural tests on the longer slabs were also performed. In these tests, pressure in an air-bag system was adjusted to provide a uniformly distributed load of 90 psf (1 psf = 47.9 N/m²) on the slabs to simulate live floor loads. The inserts were then tested individually to failure as previously described.

Two types of sustained-load tests were performed to determine the maximum load that could be carried by an insert for an indefinitely long period of time. The first consisted of slowly increasing the load at a constant rate until failure occurred. The rate of loading was varied from 45 lbs/hr to 2000 lbs/min in an effort to determine the relationship between failure load and rate of loading.

The second type of sustained load test consisted of maintaining a constant predetermined pull-out load on the insert. Loads applied were 80, 85, and 90 percent of the failure loads of short-term static tests on companion specimens.

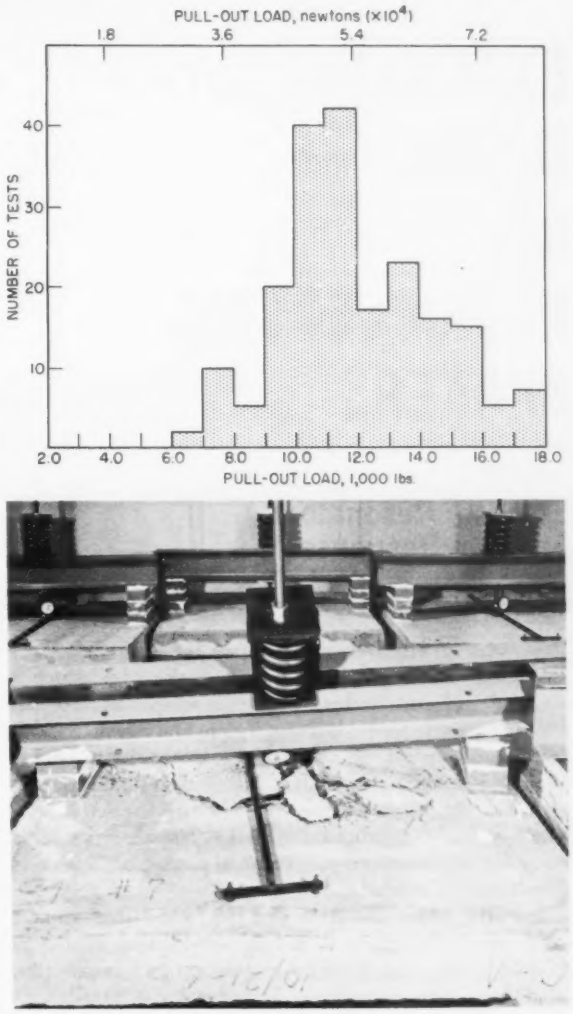
Two series of cyclic fatigue tests were made on the inserts. The first tests were on inserts embedded in 42 in × 45 in slabs, while the second series was on inserts embedded in 42 in × 15 ft 9 in slabs. The small specimens were fatigue loaded on a span of 42 in, with a minimum load of 3000 lbs for all specimens. The maximum load was varied so that the ratio of minimum to maximum varied from 0.30 to about 0.43.

The longer length fatigue test specimens were cast with inserts spaced so that each specimen had two inserts available for fatigue tests on a 10 ft span.

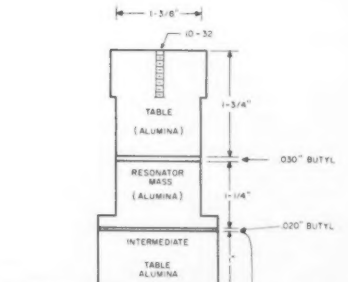
While it is difficult, with so many variables involved, to make broad general statements regarding the results, it was found that a mean value of 12 000 lbs with a standard deviation of 2500 lbs pull-out load could be associated with the 42 in × 45 in specimens. Fatigue test results indicate that the fatigue strength for 2 million cycles is about 65 percent of the static strength for these same specimens in normal weight concrete. Load-carrying capacity of the 3 types of inserts varied but little.

An increase in concrete compressive strength caused a predictable increase in insert pull-out strength. The amount of reinforcing steel and its location affected the insert pull-out strength very little. In addition, the tests revealed that no reduction in strength occurred when the inserts were set at angles of 20° from perpendicular.

[1] For complete details see, Reichard, T. W., Carpenter, E. F., and Leyendecker, E. V., Nat. Bur.Stand. (U.S.), Building Science Series, Design Loads for Inserts Embedded in Concrete. (In preparation.)

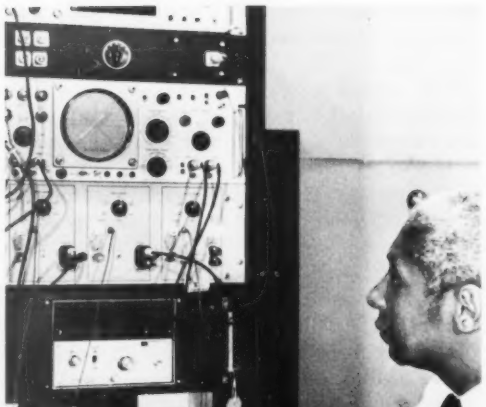


Histogram of more than 200 static tests on inserts embedded in reinforced concrete slabs. The data are for three types of inserts embedded in concrete slabs. Concrete-embedded insert tested to failure in a sustained load test. A predetermined load was exerted by compressing the spring with a hydraulic jack.



EXTENDING RANGE OF PIEZOELECTRIC SHAKERS

Stacked Resonators Smooth Response



Above left: The configuration of a wide-range piezoelectric shaker, S–89, which can be used over a frequency range of 55 kHz.
Above: Earle Jones studies motion generated by an experimental shaker as he changes the frequency of the driving signal originating from the oscillator.

RESEARCH AT THE Bureau's Institute for Basic Standards has greatly extended the frequency range over which a single piezoelectric shaker can provide acceptable response. Physicists Earle Jones, William Yelon, and Seymour Edelman accomplished this by adding to the basic shaker several elements contributing damped resonances that maintain the response over higher frequencies. Now a single shaker can calibrate vibration transducers over a range for which several conventional piezoelectric shakers were formerly needed.[1]

Industry, space research, and the armed forces make great use of vibration transducers in testing prototype models, conducting acceptance testing, and monitoring conditions during operation. In order for a transducer's indications to be accurate, it must be calibrated and its characteristics known over the frequency and displacement ranges to be encountered. The Bureau calibrates vibration references for government and industrial standards laboratories and is working on improved measurement procedures and instrumentation.

Shaker Characteristics

Shakers using piezoelectric materials produce "good" motion at useful frequencies, but have sharp variations of displacement over any band of frequencies. Because the typical piezoelectric shaker has linear response over only a narrow range below its resonant frequency, several shakers are needed to perform a calibration. Both measurement accuracy and reproducibility would be improved if each piezoelectric shaker could be used over a wider frequency range.

The conventional piezoelectric shaker consists of a section of piezoelectric material sandwiched between a massive base and a "table," which has a threaded hole for mounting transducers. The piezoelectric material alternately thins and thickens with application of the sinusoidal

driving signal. The base and table form with the piezoelectric layer a mechanically resonant system characterized by a high Q, which therefore has at its resonant frequency a sharp peak of displacement versus input power.

Multiple Resonance in Shakers

The new NBS shaker consists, typically, of a base-driver-table unit like a simple shaker, to the top of which is added an intermediate resonator section and another table. Thin butyl rubber layers couple the resonator section to the new table and to the original table below. The base of the basic shaker is mounted on a second resonator section with another layer of rubber.

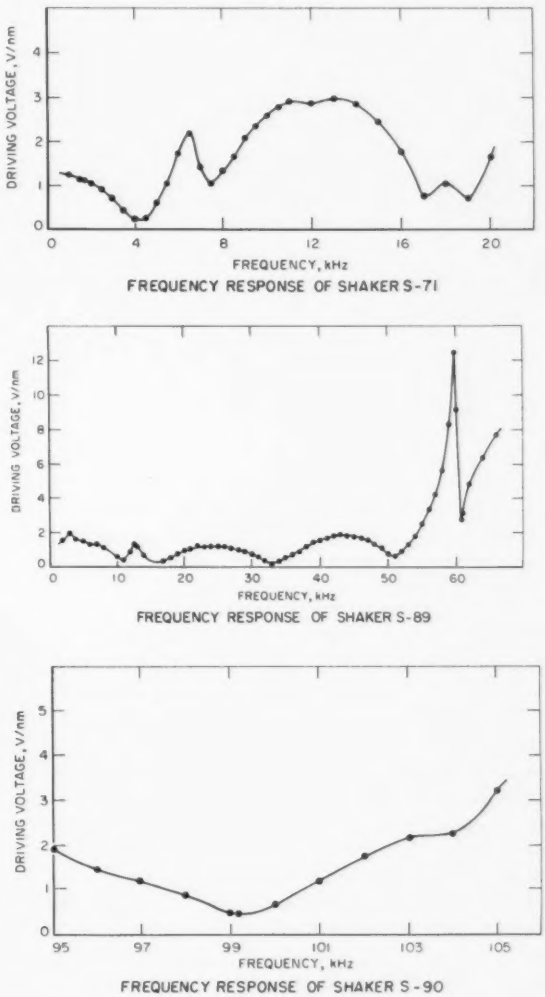
One experimental shaker, S-89, requires for constant displacement a driving voltage that is relatively flat from 100 Hz to 55 kHz. Above this the driving voltage required for this displacement soars to a sharp peak. The plot of driving current versus frequency for this shaker has dips identifying four resonant frequencies of approximately 11, 16, 33, and 52 kHz, all of them within its useful frequency range. A similar shaker is used to perform calibrations from 1 to 20 kHz, over which range three conventional shakers formerly did a less satisfactory job.

It is interesting to note that widening the response of shakers by selecting added resonances is analogous to the stagger-tuning technique that is used to shape the bandwidths of electrical tuned circuits.

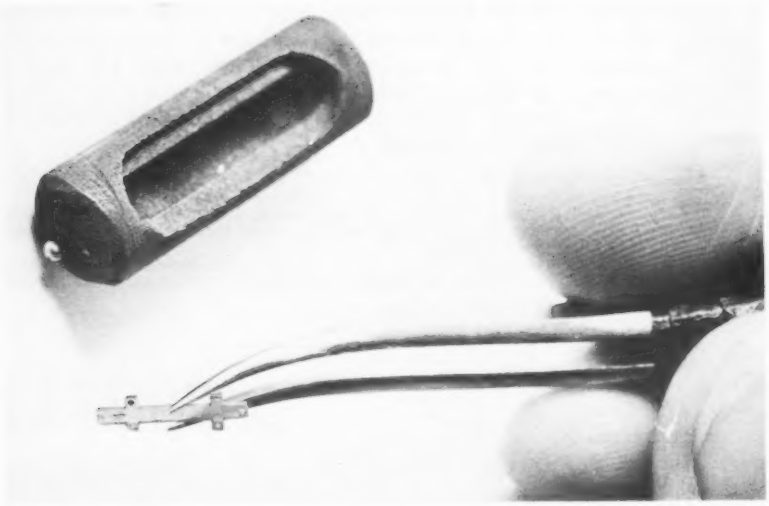
The piezoelectric material itself provides almost ideal pistonlike motion in its intended range, but the butyl rubber layers degrade the motion progressively at frequencies above 50 kHz. For this reason Bureau scientists are investigating other materials for the damping layers. Some piezoelectric materials have been found to be satisfactory for this function. Particularly promising is the possibility of shaping the loss characteristics by connecting various electrical impedance networks between the two faces of the damping layer. Also being studied is application of part of the driving signal, suitably shifted in phase, to the damping layer.

[1] Jones, E., Yelon, W. B., and Edelman, S., **Piezoelectric shakers for wide-frequency calibration of vibration pickups**, J. Acoust. Soc. Am. **45**, 1556–1559 (June 1969).
Earlier Bureau use of ceramic materials in accelerometers is described in **Ceramics used for transducer components**, NBS Tech. News Bull. **48**, 219 (Dec. 1964).

Oliver Price mounts an accelerometer to be calibrated atop a new type of piezoelectric shaker. The stacked elements of the shaker contribute resonances that extend the range of frequencies.



The plots of driving voltage necessary to obtain standard displacement are shown for multiresonant piezoelectric shakers used for three frequency ranges.



A semiconductor oxide shows the indentation (black dot) into which a hydride flux and a metal contact will be pressed. The semiconductor oxide, with contacts, will be placed in the carbon boat and inserted into an rf furnace to heat seal the contacts.

LOW RESISTANCE CONTACTS FOR HIGHLY SENSITIVE MEASUREMENTS

Sensitive Measurements in Semiconductor Research, for example in obtaining magneto- and piezo-resistance data, need lower contact resistances than conventionally made contacts can provide. William R. Hosler of the NBS Institute for Materials Research, with NASA support, devised and developed a new method [1] for producing low resistance, sturdy electrical contacts. Such improvements in contact technology will benefit assembly operations of electronic circuits containing devices such as thermistors, diodes, and photodetectors.

Making Contact

An ultrasonic drill is used to make an indentation in the semiconductor into which a contacting metal is pressed. A titanium dihydride flux is sandwiched between the metal and the semiconductor in the hole measuring approximately 0.25 mm in diameter and 0.1 mm in depth. The semiconductor, with its metal and flux in place, is fitted into a carbon boat, covered, inserted into a fused silica tube, and heated in an rf furnace to 800 °C for 90 seconds. Heating may be done in either a vacuum or a helium atmosphere. Only those materials whose bulk characteristics are not substantially altered by vacuum or inert gas at elevated temperatures for a short time can be contacted by this method.

The semiconductor oxides on which the contacts were made and tested include potassium tantalate ($KTaO_3$), strontium titanate ($SrTiO_3$), titanium dioxide (TiO_2), and barium titanate ($BaTiO_3$). Indium, lead, spongy platinum, and gold were used as the contacts on each of the above semiconductors.

Evaluation Procedure

Tests were performed to determine the contact resistances for the various metals on each semiconductor oxide at 300, 78, and 4.2 K. Six contacts were made on each semiconductor oxide sample. Four contacts were hydrided as described here, while two were conventionally made by directly soldering to the semiconductor. Two wires were soldered to each of the four contacts; one wire to each of the remaining two contacts. These wires permitted measurement of both the bulk resistance and the resistance of the bulk plus contact. By subtracting one obtains the resistance of the two current lead contacts. The use of two additional wires enables potentiometric measurement of the potential drop between two contacts without having a current flowing simultaneously through the wires—thus eliminating the need to compensate for an I-R drop in the wires.

A typical decrease in contact resistance is shown by the example of indium contacted onto a strontium titanate semiconductor. Conventional contacting methods, such as soldering, gave a contact resistance of 0.2 ohm at 4.2 K, while the same materials contacted by the described method gave 0.002 ohm under identical conditions.

[1] Hosler, W. R., **Low resistance contacts in semiconductor oxides**, Sol. St. Electron. (to be published).

NSRDS NEWS

The NSRDS was established to make critically evaluated data in the physical sciences available to science and technology on a national basis. The NSRDS is administered and coordinated by the NBS Office of Standard Reference Data.

Prototype General Purpose Scientific Document Writers Installed

In April 1969, the NBS Office of Standard Reference Data reported [1] on the development of a General Purpose Scientific Document Image Code (GPSDIC) system that would relieve the scientist of the necessity of changing his scientific reports to meet the arbitrary restraints normally associated with machine processing.

Recently, two high-speed line printers that meet the specifications of a General Purpose Scientific Document Writer (GPSDW) for use with the GPSDIC system have been put into operation. One of these is in use at the NBS Clearinghouse for Federal Scientific and Technical Information; the other has been installed at the NIH National Library of Medicine.

The system was designed by Blanton C. Duncan and David Garvin of the NBS Physical Chemistry Division under the sponsorship of the NBS Office of Standard Reference Data. Their task was to design and test a system suitable for the automated handling and exchange of information in and among the data centers cooperating with the National Standard Reference Data System (NSRDS). The pilot work was done with the cooperation of the Chemical Thermodynamics Data Group and the Chemical Kinetics Information Center located in the NBS Physical Chemistry Division. As the work progressed, the Specialized Information Services group at the National Library of Medicine joined in supporting this effort.

One of the design objectives for the GPSDIC system was to assure that the information in stored records could be disseminated on magnetic tape or telecommunication links in a coded character set that is compatible with the American National Standards Institute (ANSI) Standard Code for Information Interchange (ASCII).[2]

A major feature of the system is a class of devices called General Purpose Scientific Document Writers (GPSDW). These devices must be capable of producing documents at the same level of symbolic complexity as found in manuscripts produced by scientific typists, such as those that require overstrikes, half-line spacing, and auxiliary typefaces. Besides a line printer, the device may be a typewriter, an x-y plotter, a cathode ray display, or any other suitable equipment.

For graphical representations, the level of sophistication required of a GPSDW lies between that needed to produce structural formulas and circuit diagrams, as illustrated in figures

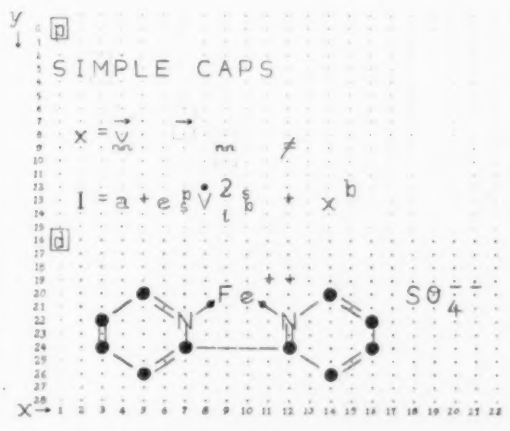


Figure 1. A model typescript page shows the x-y coordinates implicit in typed text produced by a General Purpose Scientific Document Writer.

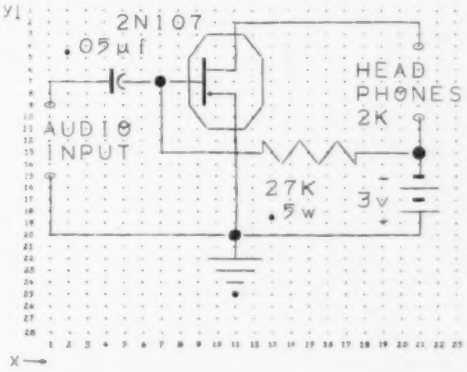


Figure 2. The GPSDW can produce diagrammatic text as illustrated by this electric circuit.

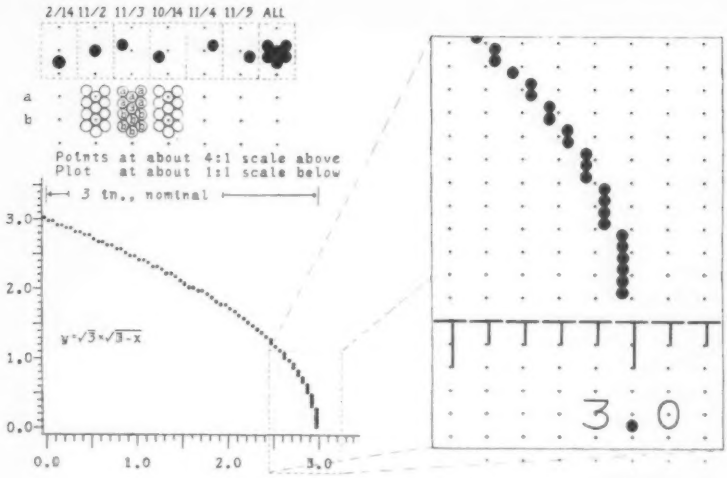


Figure 3. Half-line spacing and overstriking double the number of striking positions of the 6 dots available in the GPSDIC system to give GPSDW's rough plotting capability. The expanded scale (right) shows the actual striking positions used to produce the curve.

Column		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Row		0	16	32	48	64	80	96	112	128	144	160	176	192	208	224	240
0	0	NUL	DLE	SP	0	@	P	`	p	ERS	-	∂	∏	°	π	BT6	BPD
1	1	SOH	DC1	!	1	A	Q	a	q	/	||	◊	¶	α	θ	nya	P1A
2	2	STX	DC2	"	2	B	R	b	r	'	•	∏	∝	β	ρ	nya	P1B
3	3	ETX	DC3	#	3	C	S	c	s	/	•	∑	Σ	∞	σ	APM	P2A
4	4	EOT	DC4	$	4	D	T	d	t	-	•	Δ	~	δ	τ	RPM	P2B
5	5	ENQ	NAK	%	5	E	U	e	u	|	•	∃	⊤	∈	υ	HME	P2C
6	6	ACK	SYN	&	6	F	V	f	v	//	←	∫	+	∫	~	nya	P3S
7	7	BEL	ETB	'	7	G	W	g	w	//	→	Γ	Ω	γ	ω	RLF	P4A
8	8	BS	CAN	(	8	H	X	h	x	∩	↑	¤	×	η	χ	RHL	P4B
9	9	HT	EM	)	9	I	Y	i	y	∪	↓	∫	¥	ι	∮	FHL	P4C
10	A	LF	SUB	*	:	J	Z	j	z	✓	-	Ξ	§	ξ	ζ	NL	P5S
11	B	VT	ESC	+	;	K	[	k	{	••	!	≠	(	κ	C	SP3	P6A
12	C	FF	FS	,	<	L	\	l	|	□	∧	Λ	\	λ	▌	S18	P6B
13	D	CR	GS	-	=	M	]	m	}	—	≈	⇒	>	μ	⊃	UC	P8S
14	E	SO	RS	.	>	N	^	n	~	•	∨	∇	-	ν	⊃	LC	BT8
15	F	SI	US	/	?	O	_	o	DEL	/	•	▌	□	ο	⊃	GSS	EPD	E0

Note: In column headings h/d
h = hexadecimal value of character at row 0
d = decimal " " " " " "
Assignments to positions marked nya are being studied, 1969 July 15

Figure 4. XC8B code table contains the complete ASCII in columns 0 through 7. Columns 8 through 15 provide the additional features needed by the GPSDIC system to handle scientific documents in all their symbolic complexity.

1 and 2, and that needed to produce smooth curves representing mathematical functions. Figure 3 illustrates the highest level of graphical sophistication attainable with a GPSDW.

During the last 18 months increased activity has been directed toward the development of standard 8-bit character codes. This activity, plus suggestions prompted by the earlier article,[1] have led to design modifications in the GPSDIC system. Deserving special acknowledgement are the comments of the late James Mullen, of Shell Development Co., who suggested significant improvements in the design of the rule segments used for representing chemical structures.

As now formulated, the specifications of a GPSDW refer directly to the character code XC8B in figure 4. The label XC8B is a mnemonic for E*x*panded *C*ode, *8*-bit, version *B*. The code is derived from ASCII under the bit 8 = 0 doctrine set forth in the standard for recorded magnetic tape.[3] This doctrine requires that columns 0 through 7 of the code table contain the ASCII characters.

The doctrine is adhered to in GPSDIC specifications with one addi-

Figure 5. This illustration shows the composition of a standard set of composite symbols.

Column		2		3		4		5		
Row		32/20	Components	48/30	Components	64/40	Components	80/50	Components	96/60
0	0	Ō	6/2 + 11/19	Ō	3/0 + 13/14			Ē	2/2 + 4/9	
1	1	Ī	6/8 + 11/19	Ī	3/1 + 13/14	Å	4/1 + 12/0	Ē	4/8 + 7/14	å
2	2	Ī	7/0 + 11/19	Ī	3/2 + 13/14	Â	4/1 + 5/14	Ę	2/12 + 4/9	â
3	3	Ī	6/4 + 11/19	Ī	3/3 + 13/14	À	4/1 + 6/0			à
4	4	Ā	6/6 + 11/19	Ā	3/4 + 13/14	Ä	2/2 + 4/1			ä
5	5	Ī	7/4 + 11/19	Ī	3/5 + 13/14	Á	2/7 + 4/1	Ģ	4/7 + 11/4	á
6	6	Ī	7/2 + 11/19	Ī	3/6 + 13/14	Ą	2/12 + 4/1			ą
7	7	Ī	6/12 + 11/19	Ī	3/7 + 13/14			Ī	4/9 + 8/14	
8	8	Ī	6/8 + 11/19	Ī	3/8 + 13/14			Ī	2/2 + 4/9	
9	9	Ī	6/8 + 11/19	Ī	3/9 + 13/14	Ç	2/12 + 4/3	Ī	2/7 + 4/9	ç
10	A	S	7/3 + 11/19			Ć	2/7 + 4/3	Ī	4/9 + 7/14	ć
11	B							€	9/0 + 11/11	
12	C							₤	2/13 + 6/3	
13	D					É	2/7 + 4/5	≤	2/13 + 3/12	é
14	E					Ê	4/5 + 5/14	≡	2/13 + 3/13	ê
15	F					È	4/5 + 6/0	±	2/11 + 3/13	è

Note: Columns 8 and 9 are to be made available for optional assignments. However, the

tional detail imposed on the specification of graphic symbols—relative striking positions of the symbols are defined for the purpose of introducing *composite* symbols. Figure 4 shows the approximate striking positions of the symbols. The three tickmarks on the left edges of the boxes indicate the positions of three vertically adjacent center lines for symbols. The two tickmarks on the right edges correspond to the base line and top of the uppercase alphabetical symbols.

In GPSDIC, a *composite* symbol consists of two, but no more than two, *simple* symbols overstruck or displayed at the same position. Figure 5 shows a particular set of composite symbols specified in GPSDIC processing. It can be seen that the limit of 188 symbols is less restrictive when symbols such as ± can be produced as composites. The limiting of a composite symbol to only two components is not inherent in XC8B, nor is it an absolute limit imposed by GPSDIC doctrines. It is, however, a fundamental element of the specification of *basic* textual data for which the standard facilities of a GPSDIC system may be expected to be used.

In addition to "overstrikes," a GPSDW must provide half-line spacing. The XC8B table contains the format effector characters FHL (forward half-line feed) and RHL (reverse half-line feed) in column 14 of figure 4. It is impossible to state all the criteria used in selecting symbols for inclusion in XC8B. In general, provisions were made for all the Greek letters that are dependably distinguishable from Latin counterparts. Various mathematical notations, including programming languages such as Algol, were considered as well as the NSRDS requirement for displaying chemical notations. The final product reflects contributions from many people over a four-to-five year period. The symbols are now regarded as fixed for the foreseeable future in order to permit the development of practical experience in user communities.

A set of typefaces for a high-speed line printer has been installed at NBS. Another set for a similar printer is at the National Library of Medicine for use with the toxicology information program. Both line printers meet the new specifications for a GPSDW; they provide half-line spacing, overstrike capability, and typefaces for each of the 188 symbols shown in figure 4.

The GPSDW at NBS was used to produce an informal report that describes the GPSDIC system. A limited number of these reports were prepared to demonstrate the effectiveness and capabilities of both the GPSDIC system and the GPSDW. Inquiries should be addressed to: Dr. B. C. Duncan, Room B154, Chemistry Building, National Bureau of Standards, Washington, D.C. 20234.

More formal reports describing and demonstrating the GPSDIC system are in preparation as NBS Technical Notes, and will be available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, in the near future.

[1] The document image code, NSRDS News, Nat. Bur. Stand. (U.S.), Tech. News Bull. 52, No. 4, 86–88 (April 1968).

[2] Code for information interchange, ANS 3.4-1968, American National Standards Institute, 10 East 40th Street, New York, N.Y. 10016.

[3] Recorded magnetic tape for information interchange (800 CPI, NRZI), ANS 3.22-1967, American National Standards Institute, 10 East 40th Street, New York, N.Y. 10016.

5		6		7		8		9		10		11		12		13	
Components	05/00	Components	05/10	Components	05/11	Components	05/12	Components	05/13	Components	05/14	Components	05/15	Components	05/16	Components	05/17
2/2+4/8			ë	2/2+6/5	▯	6/7+11/15							Ù	5/5+5/14			ù	5/14+7/5
4/5+7/14	å	6/1+12/0	ẽ	6/5+7/14							Ñ	4/14+7/14	Ù	5/5+6/0		ñ	6/14+7/14	ù	6/0+7/5
2/12+4/5	â	5/14+6/1	ę	2/12+6/5							Ń	2/7+4/14	Ü	2/2+5/5		ń	2/7+6/14	ü	2/2+7/5
	à	6/0+6/1											Ũ	5/5+7/14				ũ	7/5+7/14
	ä	2/2+6/1																	
4/7+11/4	á	2/7+6/1	ğ	6/7+11/4							Θ	4/15+5/14				ô	5/14+6/15		
	ą	2/12+6/1									Ö	2/2+4/15	Ź	2/7+5/10		ö	2/2+6/15	ź	2/7+7/10
4/5+5/14			î	5/14+6/5							ϕ	2/15+4/15	Ż	5/10+6/0		ϕ	2/15+6/15	ż	6/0+7/10
2/2+4/5			ï	2/2+6/5							Ó	2/7+4/15				ó	2/7+6/15		
2/7+4/5	ç	2/12+6/3	ł	2/7+6/5							Θ	4/15+7/14				õ	6/15+7/14		
4/5+7/14	ć	2/7+6/3	ţ	6/5+7/14															
5/0+11/11			ŷ	5/10+11/13									÷	2/13+3/10				ß	5/2+8/12
2/15+4/3			Ŵ	5/6+11/14							Ş	2/12+5/3				ş	2/12+7/3	Q	4/3+8/12
2/13+3/12	ê	2/7+6/5	≥	2/13+3/14							Ś	2/7+5/3				ś	2/7+7/3		
2/13+3/13	ê	5/14+6/5	≠	2/15+3/15									Φ	4/9+12/15				ϕ	2/15+12/15
2/11+2/13	è	6/0+6/5	▨	Not Valid									Θ	3/0+8/4				▨	11/15+7/8

nents. However, the 31 composites of ▯, 11/15, with 1 through 9 and A through V are reserved as the stock default assignments.

High-Voltage Probe

EVALUATES PORCELAIN ENAMEL COATINGS

ONE OF THE MAIN FUNCTIONS of a porcelain enamel coating is protecting a substrate from corrosion. With the present day trend to one-coat and matte enamels, complete protection is often lacking. Exposure testing has pointed up a need for a rapid continuity-of-coating test that is capable of locating both minute discontinuities and lightly coated areas, which are subject to corrosion.

To meet this need, M. A. Baker, Research Associate working at the NBS Institute for Applied Technology under the sponsorship of the Porcelain Enamel Institute, has devised a high-voltage probe method for evaluating enamel coating continuity and poor coverage areas.[1] The procedure is easy to use and should prove highly useful for testing and quality control of porcelain enamel coatings.

The test procedure requires a high-voltage source, either ac or dc, whose output voltage is continuously variable from 0 to 4 kV; a test probe constructed from 100-mesh wire gauze; and a nondestructive thickness gage for determining the enamel thickness.

The first step in the procedure is determining the air-gap voltage curve of the test equipment, which represents the relationship between minimum voltages required to arc across punctures of various lengths. Lengths of punctures are assumed to be the same as the measured thicknesses of the enamels.

The air-gap voltage curve is determined from a sufficient number of enamels to establish a well-defined curve (approximately 45) with a range of thicknesses between 0.01 and 0.045 mm. With the ground wire of the test equipment connected to the base metal of the specimen, and the voltage output raised to its maximum, the specimens are probed to puncture as many of them as possible.

The punctured specimens are then reprobed with an initial voltage of 100 volts, which is increased in increments of 100 volts until arcing occurs. (Arcs are readily seen or heard.) A relationship is thus established between voltage and air gaps of known lengths.

The apparatus may then be used to evaluate other specimens for coating continuity. In this case, the thickness of the specimen's enamel coating is first measured. The air-gap voltage is determined for this thickness from the air-gap curve previously determined. The specimen is then probed with this voltage as a minimum, which reveals any discontinuities. Overvoltages (voltages higher than the air-gap voltage) may be arbitrarily chosen and applied for routine quality control purposes.

In an evaluation of the high-voltage probe method, it was used to select one-half of a group of specimens to be exposed to outdoor weathering. Specimens were selected on the basis that they pass a high-voltage probe test in which overvoltages from 0.5 to 1.6 kV were applied. After one year's exposure, 26 of the randomly selected specimens corroded, while only 12 of those passing the probe test were so affected. This indicates that even at low overvoltages, the high-voltage probe is capable of locating enamels with poor coverage and should serve as a valuable tool in the quality control of porcelain enamels.

[1] Baker, M. A., Continuity of coating test and suggested applications, Proceedings of the 31st Annual PEI Forum, Columbus, Ohio, Nov. 5-6, 1969 (to be published).

RADIOCHROMIC DYES *continued*

calorimeters provided response data in terms of the number of dye molecules produced per unit of radiation absorbed by the system, known as the G-value of dye response. The response was determined by relating optical density at the wavelength of maximum absorption of the dye to the absorbed dose in the material of interest. These measurements were made with high precision photoelectric densitometers or spectrophotometers.

Radiation dose distributions were measured by placing the dosimeters in phantoms simulating experimental containers used in industrial radiation processing and irradiating them using a variety of radiation sources and geometries. The dose distributions near interfaces were measured by placing thin dye films in the phantom at a slight angle to the direction of the beam. Good agreement was found between the experimental depth-dose data based on theoretical Monte-Carlo calculations of M. J. Berger and S. M. Seltzer of the NBS Center for Radiation Research.

[1] McLaughlin, W. L., and Hussmann, E. K., The measurement of electron and gamma-ray dose distributions in various media, Proceedings of Symposium on the Utilization of Large Radiation Sources and Accelerators in Industrial Processing, Aug. 18–22, 1969, Munich, Germany, IAEA/SM–123/43 (to be published).

[2] Chalkley, L., Photometric papers sensitive only to short wave ultraviolet, J. Opt. Soc. Amer. 42, 387-392 (1952).

STANDARDS AND CALIBRATION

STANDARD FREQUENCY AND TIME BROADCASTS

High-frequency radio stations WWV (Fort Collins, Colo.) and WWVH (Maui, Hawaii) broadcast time signals on the Coordinated Universal Time (UTC) system as coordinated by the Bureau International de l'Heure (BIH), Paris, France. These NBS time signals, UTC (NBS), are maintained within 5 microseconds of the corresponding time signals of the U.S. Naval Observatory, UTC(USNO). The UTC pulses occur at intervals that are longer than one coordinate second by 300 parts in 10^{10} during 1970, due to an offset in carrier frequency coordinated by BIH. To maintain the UTC scales in close agreement with the astronomers' time, UT2, phase adjustments are made at 0000 hours Greenwich Mean Time (GMT) on the first day of a month as announced by BIH. *There will be no adjustment made on March 1, 1970.*

The low-frequency radio station WWVB (Fort Collins, Colo.) broadcasts seconds pulses without offset to make available to users the standard of frequency so that absolute frequency comparisons may be made directly, following the Stepped Atomic Time (SAT) system. Step time adjustments of 200 ms are made at 0000 hours GMT on the first day of a month when necessary. BIH announces when such adjustments should be made in the scale to maintain the seconds pulses within about 100 ms of UT2. *There will be no adjustment made on March 1, 1970.*

NBS obtains daily UT2 information from forecasts of extrapolated UT2 clock readings provided by the U.S. Naval Observatory with whom NBS maintains close cooperation.

NEW DENTAL FILLINGS FOR FRONT TEETH

Material Being Evaluated at NBS

DENTAL RESEARCHERS at the Bureau have developed and are testing a new dental material for front tooth restorations.

A major deficiency of present anterior materials is their radiolucency. Because of this radiolucency, the present fillings are dark on an x-ray film, as are cavities and void spaces. Therefore, the dentist cannot detect decay around or under the fillings nor can he determine whether he has completely filled the tooth. One of the primary advantages of the new material is that it is radiopaque (as is the normal tooth), making x-ray diagnosis easier. In addition, it closely resembles the color and translucency of the natural teeth.

The radiopaque material formulated by Bureau scientists is a composite formed of a dimethacrylate resin,[1] a radiopaque glass,[2] and fused silica. It is now under long-term clinical evaluation by H. H. Chandler, R. L. Bowen, G. C. Paffenbarger, and A. L. Mullineaux, American Dental Association Research Associates at NBS, with partial support from the National Institute of Dental Research.

One-hundred and ten restorations are being clinically evaluated for changes in color, flushness at the tooth-restoration margin, surface condition, recurring caries, and condition of the adjacent soft tissues. Initial evaluation of the restorations indicated excellent esthetic values and compared favorably with a commercially available radiolucent composite material.

The restorations were placed in pairs for the purpose of evaluating a second new dental material, a cavity primer* used to provide possible adhesion between the cavity surface and the restoration. (At present, a restoration is held in place not by adhesive forces but by the shape of the cavity.) In the 55 pairs of restorations, the cavity surfaces of one of each pair were treated with the primer, while the other half remained untreated to serve as a control. The data will show the effects of the primer, if any, on the integrity and staining of the restorations' margins and tooth sensitivity.

*N-(2-hydroxy-3-methacryloxypropyl)-N-phenylglycine.

[1] Bowen, R. L., Crystalline dimethacrylate monomers (to be published).

[2] Bowen, R. L., and Cleek, G. W., X-ray-opaque reinforcing fillers for composite materials, J. Dent. Res. 48, 79 (Jan.-Feb. 1969).

FIPS NOTES

INTERNATIONAL STANDARDS FOR INFORMATION PROCESSING

In the development of voluntary national standards for information processing, NBS is responsible for monitoring and coordinating Federal government participation on the various subcommittees and task groups of the American National Standards Institute (ANSI) and other industry standardization bodies. ANSI provides the channel through which American interests can participate in the activities of international standardization, which are becoming as important as national standardization activities. On many occasions, government participants are requested to consider international proposals and represent the interests of the United States on various standardization groups of the International Organization for Standardization. Also, government agencies may be queried as to the appropriateness of selected international proposals. Of particular importance to the information processing community is the work being carried on by ISO and its Technical Committee 97 (Computers and Information Processing). A review of ISO's activities in this area should be of interest to the entire information processing community.

Organization and Function of ISO

ISO was established in 1947 to promote the development of standards in order to facilitate international exchange of goods and services, and to develop mutual cooperation in areas of intellectual, scientific, technological, and economic activity.

Its objectives, as specified in its constitution, are: "... to facilitate the coordination and unification of the standards of Member Bodies." In connection with this goal, ISO may "organize the exchange of information regarding the work carried out by each Member Body . . . , set forth principles for the guidance of Member Bodies in their work . . . , cooperate with other international organizations dealing with related questions . . . , set up international standards provided, in each case, no Member Body dissents."

Central Secretariat of the International Organization for Standardization (ISO), Geneva, Switzerland.

Present membership in ISO includes 54 Member Bodies. A Member Body is an organization of an individual Nation that best represents the standardization activities of its Nation. Only one such body for each country can be an ISO Member Body. The ISO Member Body that represents the United States is the American National Standards Institute (ANSI).

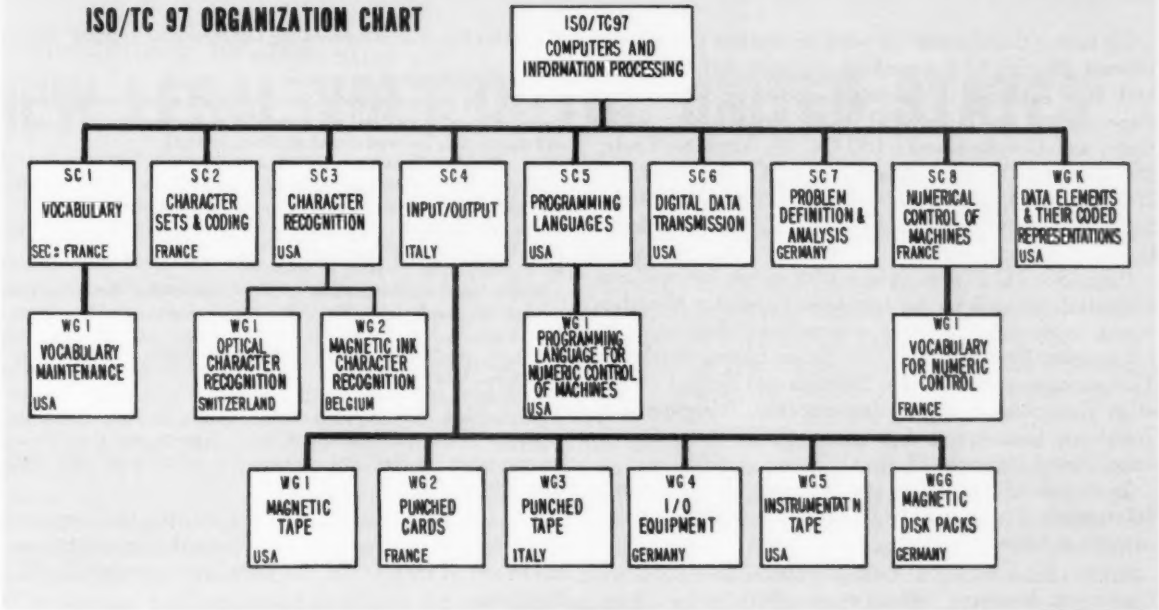
The operations of the Organization are directed by the ISO Council, which consists of the President, currently M. F. A. Sunter of Turkey, and representatives of 14 Member Bodies. An Executive Committee, composed of the Vice-President and seven Member-Body representatives, supervises the activities of the Central Secretariat and is responsible to the Council.

The principal administrative officer of the Organization is the Secretary-General, who is elected by the Council and is in charge of the Central Secretariat. This post is currently held by O. Sturen of Sweden. The Secretary-General ensures liaison between Member Bodies and the Council, regulates expenditures, and, in general, represents ISO in its relations with other international organizations.

As coordinator of the activities of the Technical Committees, the Secretary General directs the work of Members and Committees, informs Member Bodies and the Council of the work carried out by Committees, and informs the Committees of activities of other international organizations in related fields.

The standardization work of ISO is accomplished by Technical Committees. Any ISO Member Body or any organization outside ISO may request the study of a technical subject. If the study is approved by a majority, and at least five Member Bodies are willing to take an active part, a Technical Committee is established by the Council.

For each Committee the Council designates one Member Body to act impartially as a Secretariat. This Member Body also has its own delegation in the Technical Committee with the same status as other participating Member



Bodies. The Secretariat is responsible for the satisfactory conduct of the Technical Committee's work and annually reports to the Council.

Currently, over 120 Technical Committees have been established. Their activities cover most technical areas, with the exception of electricity. All matters of an electrotechnical nature are considered by the International Electro-technical Commission (IEC), which is affiliated with ISO.

The scope of each Technical Committee is precisely defined and can be altered only with the approval of the ISO Council. Within that scope, each Technical Committee determines its own program of work. Members who take an active part in the work of a Technical Committee are known as (P) Members (participating) and have the right to vote. Members who wish only to be kept informed of the Committee's work are called (O) Members (observers) and may not vote.

Technical Committees may establish Sub-Committees to study items on the Committee's work program. Working Groups are set up under Technical Committees and Sub-Committees as required. Reports of Working Groups and Sub-Committees are normally in the form of preliminary draft proposals.

Draft proposals intended to become ISO Recommendations are submitted to the (P) Members of a Technical Committee for consideration. Those receiving substantial support are registered by the Central Secretariat as Draft ISO Recommendations and circulated to the Committee's (P) Members for final letter ballot and to all ISO Member Bodies for approval. A Draft ISO Recommendation, adopted by a majority of the (P) Members and approved by 60 percent of all ISO Member Bodies, is submitted to the ISO Council for acceptance as an ISO Recommendation. ISO Recommendations are published by the Central Secretariat for use of Member Bodies in facilitating standardization in their respective countries.

ISO/TC 97 (Computers and Information Processing)

Technical Committee ISO/TC 97 is responsible for developing standards recommendations relating to Computers and Information Processing. This Committee's development work is accomplished through the efforts of eight Sub-Committees and twelve Working Groups.

Members participating at the Committee, Sub-Committee and Working Group levels of ISO/TC 97 include the following countries:

(P) Members

Australia	Germany	Rumania
Brazil	Italy	Sweden
Canada	Japan	Switzerland
Czechoslovakia	Netherlands	United Kingdom
Denmark	Poland	USA
France	Spain	USSR

(O) Members

Austria	India	Pakistan
Belgium	Iran	Portugal
Chile	Ireland	Republic of South Africa
Columbia	Israel	
Greece	New Zealand	Turkey
Hungary	Norway	Yugoslavia

To ensure coordination of work on matters of common interest, ISO/TC 97 has established liaison with other ISO and IEC Technical Committees, including ISO/TC 6, Paper, Board, and Pulps; ISO/TC 37, Terminology (Principles and Coordination); ISO/TC 39, Machine Tools; ISO/TC 46, Documentation; ISO/TC 68, Banking; ISO/TC 95, Office Machines; IEC/TC 44, Electrical Equipment of Machine Tools; and IEC/TC 53 Analogue Computing Equipment.

Also ISO/TC 97 has liaison with many International Organizations such as the European Computer Manufacturers Association (ECMA), International Federation of Information Processing (IFIP), Union Internationale des Telecommunications (UIT), International Radio Consultative Committee (CCIR), International Telegraph and Telephone Consultative Committee (CCITT), and Universal Postal Union (UPU).

In its role of developing standards for Computers and Information Processing, ISO/TC 97 has a defined scope of work as follows:

> Standardization of the terminology, problem description, programming languages, communications characteristics, input-output, and physical (non-electrical) characteristics of computers and data processing devices, equipments and systems.

The Sub-Committees and Working Groups within ISO/TC and the scope of work of each Sub-Committee are:

SC 1—Vocabulary

Scope: To provide a multilingual glossary for information processing systems and related subjects covered in the general scope of ISO/TC 97 and, where appropriate, abbreviations and letter symbols.

Working Group 1—Vocabulary Maintenance

SC 2—Character Sets and Coding

Scope: The standardization of character sets, character meanings, the grouping of character sets into information, coded representation and the identification of it for the interchange of information between data processing systems and associated equipments, also to report on the problems related to analog devices, taking into account the need for error checking.

SC 3—Character Recognition

Scope: The standardization of input and output character forms for the interchange of information between data processing equipments and associated equipments utilizing only humanly-legible printed character sets, i.e., character recognition.

Working Group 1—Optical Character Recognition

Working Group 2—Magnetic Ink Character Recognition

SC 4—Input-Output

Scope: The standardization of those physical characteristics of input-output media which are required for the interchange of digital and/or coded information among information processing systems and systems of associated equipment.

Working Group 1—Magnetic Tape

Working Group 2—Punched Cards

Working Group 3—Punched Tape

Working Group 4—Input-Output Equipment

Working Group 5—Instrumentation Tapes

Working Group 6—Magnetic Disk Packs

SC 5—Programming Languages

Scope: The standardization and specification of common programming languages and the characteristics of other software of broad utility, with provision of revision, expansion and strengthening, and for the definition and approval of test problems.

Working Group 1—Programming Languages for Numerical Control of Machines

SC 6—Digital Data Transmission

Scope: To determine and define the system parameters governing the operational action and reaction between communication systems and digital data generating and receiving systems.

SC 7—Problem Definition and Analysis

Scope: To establish appropriate standards on definition and analysis of information processing problems in order to define the means, the format, the context and other techniques which will provide a representation of these problems.

SC 8—Numerical Control of Machines

Scope: Any standardization problem concerning the numerical control of machines; this definition includes, among others, machine-tools, assembling machines, welding and torch-cutting machines, winding machines, drafting machines, inspection and sorting machines.

Working Group 1—Vocabulary

Working Group K—Data Elements and Their Coded Representation

Scope: The standardization of data elements and their coded representation to facilitate information interchange and data processing.

Fourteen ISO Recommendations relating to Computers and Information Processing have been developed through the efforts of ISO/TC 97 and have been approved by ISO Members.

Approved ISO Recommendations Relating to Computers and Information Processing

R 646-1967	6- and 7-bit Coded Character Sets for Information Processing Interchange
R 840-1968	Code for the Numerical Control of Machines. (Compatible with the ISO 7-bit Code)
R 841-1968	Axis and Motion Nomenclature for Numerically Controlled Machines
R 961-1969	Implementation of the 6- and 7-bit Coded Character Sets on 7-track 12.7 mm (½ in) Magnetic Tape
R 962-1969	Implementation of the 7-bit Coded Character Set on 9-track 12.7 mm (½ in) Magnetic Tape
R 963-1969	Guide for the Definition of 4-bit Character Sets derived from the ISO 7-bit Coded Character Set for Information Processing Interchange
R 1001-1969	Magnetic Tape Labelling and File Structure for Information Interchange
R 1004-1969	Print Specifications for Magnetic Ink Character Recognition
R 1056-1969	Alphanumeric Character Sets for Optical Character Recognition
R 1057-1969	Punched Tape Block Formats for the Numerical Control of Machines—Coding of Preparatory Functions G and Miscellaneous Functions M
R 1058-1969	Punched Tape Variable Block Format for Positioning and Straight-Cut Numerically Controlled Machines
R 1059-1969	Punched Tape Fixed Block Format for Positioning and Straight-Cut Numerically Controlled Machines
R 1073-1969	Interchangeable Punched Tape Variable Block Format for Positioning and Straight-Cut Numerically Controlled Machines
R 1208-1969	Flowchart Symbols for Information Processing

These ISO Recommendations are available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

Nomenclature for the

NEW LEGAL VOLT IN THE UNITED STATES

On January 1, 1969, a new base of reference for the volt, the practical unit of electromotive force (emf) or voltage, was adopted by the United States and eight other countries. Under this change, the value of the U.S. legal volt, as maintained by a group of standard cells at the Bureau, was changed by 8.4 parts per million from its previous value. If a standard cell, for example, had been assigned an emf of 1.018 320 0 volts prior to January 1, 1969, it is now assigned an emf of 1.000 008 4 × 1.018 320 0 volts, or 1.018 328 6 volts. The new value represents a better measurement of the voltage of standard cells in terms of the theoretical unit of emf derived from the basic mechanical units of length (meter), mass (kilogram), and time (second).

The question has been raised as to how the new U.S. legal volt should be designated and how it should be distinguished from the one adopted in 1948. In answer, the U.S. legal volt adopted in 1969 should be referred to as the U.S. legal volt of 1969, V_{US-69}, and the U.S. legal volt adopted in 1948 should be referred to as the U.S. legal volt of 1948, V_{US-48}.

Adoption of the new volt by the U.S. was coordinated internationally to bring the volt units of 10 countries into agreement, as of January 1, 1969. This action was taken by the International Committee on Weights and Measures, at its meeting during October 1968, on the recommendation of its Advisory Committee for Electricity. It was the first change in the reference base for the volt that the International Committee made since 1946, when it recommended a conversion from the "international" electrical units to the "absolute" system. The recommendation of the International Committee was universally adopted January 1, 1948. The volt used prior to 1948 was referred to, generally as the "international volt," or specifically (for U.S.) as the "international volt (U.S.A.)" or "U.S. legal volt," and after 1948 as the "absolute volt," or specifically as the "U.S. legal absolute volt." Other countries designated their legal volt accordingly.

ASTIN APPOINTED TO FRANCO-AMERICAN COORDINATION GROUP

Three distinguished scientists and administrators have been designated to provide high-level coordination for an expanded program of scientific and technical cooperation between France and the United States.

Allen V. Astin, former NBS Director, has been asked by the U.S. Department of State to represent the United States. M. Pierre Laurent, Director General for Cultural and Scientific Relations and Technical Assistance for Development at the Foreign Ministry and Dr. Pierre Aigrain, Delegate-General for Scientific and Technological Research will serve for France. The purpose of the group is to provide a channel for continuing liaison, to establish a flow of information on the status and development of cooperative arrangements, and to search for new scientific and technical areas of mutual interest.

The establishment of this group is an outgrowth of talks begun in September 1969 between President Nixon's Science Advisor, Dr. Lee A. DuBridge, and the French Minister for Industrial and Scientific Development, M. Francois X. Ortoli. The discussions concerned ways to expand scientific and technical cooperation between the two countries. Since then, a number of French and American officials have met to discuss specific cooperative projects in building technology, urban development, environmental pollution, marine sciences, metrology, transportation and medicine. In addition, work has progressed on the development of the terms of reference under which the National Science Foundation of the United States and the French National Center for Scientific Research will organize and expand the exchange of scientists.

CONFERENCE & PUBLICATION *Briefs*

50th ANNIVERSARY SYMPOSIUM ON DENTAL MATERIALS RESEARCH

A Symposium on Dental Materials Research was held at the National Bureau of Standards October 6–8, 1969, on the occasion of the fiftieth anniversary of the dental research program at NBS. The Symposium brought together many outstanding researchers in the field for a comprehensive examination of the present state of research and a look at future dental needs and expectations. Of the 250 registrants, 56 were from 16 foreign countries.

In attendance were all chiefs of the NBS Dental Research Section during its 50-year history—Dr. Wilmer Souder, Dr. Irl C. Schoonover, Mr. William T. Sweeney, and Dr. James M. Cassel.

The program covered the broad dental materials field—from an examination of the oral environment to a consideration of future needs from the viewpoints of dental practice, dental education, dental industry, and basic science. Invited papers covered metals research, new developments in nonmetallic restorative materials, dynamic methods for determining the mechanical properties of dental materials, and problems of evaluating dental materials and making such evaluations useful to clinical dentistry through the development of specifications.

The speakers emphasized the need for more research on the interrelations of dental restorative materials, natural dental structures, and the oral environment. Many pointed out the need for basic research to better understand the oral system and to improve materials and methods. Research to determine valid relationships between the physical and chemical properties of dental materials and clinical service was of major interest to speakers involved in the development of specifications. For this purpose, not only must properties of the material be measured, but realistic methods for evaluating clinical service must also be determined.

In the Symposium's opening session, Dr. Souder and Mr. Sweeney traced the history and development of the NBS dental research effort from its beginning in 1919 to its present broad program of research in materials and tooth structure. They emphasized that the program has developed in cooperation with the dental profession, dental schools, and dental industry, and could not have attained its present stature without the long range support of the American Dental Association (ADA), the dental services of the Army, Air Force, and Veterans Administration, and the National Institute of Dental Research (NIDR).

Dr. Schoonover charged the conferees with the responsibility of looking to the future of new materials, giving particular attention to the properties of biological materials and the relationships between dental materials and the oral environment. The need for research on the oral structure and environment was further emphasized by Dr. Richard C. Greulich, Director of Intramural Research, NIDR.

Dr. Floyd A. Peyton, University of Michigan, stressed the importance of basic research for developing new biomaterials for dentistry. Dr. John F. Glenn, Dentsply International, Inc., indicated that in the dental industry research on product development must depend largely on government supported research to provide information on properties required in dental materials, on methods of evaluating materials, and on basic studies that may lead to new types of dental materials. Dr. Henry I. Copeland, Jr., USAF, pointed out the need of the Federal Dental Services for a translation of research results into methods and techniques applicable in clinical dentistry. Looking toward the future, Dr. Ralph W. Phillips, Indiana University, called attention to the need for research to make dental care more widely available and to direct it toward prevention of tooth destruction rather than repair after destruction.

The clinical and basic properties of dental amalgam and dental casting alloys were covered in a session on metals research. Dr. Knud Dreyer Jorgensen, Royal Dental College, Copenhagen, discussed the effect of corrosion on the marginal fracture of dental amalgam restorations. Dr. H. G. F. Wilsdorf, University of Virginia, reported on recent research on the physical and chemical properties of the silver-tin, silver-mercury and tin-mercury phases present in dental amalgam. With regard to the precision casting of dental restorations, Dr. Kamal Asgar, University of Michigan, pointed out that if the dimensional accuracy of dental castings is to be improved, further investigations must be made of the effects of strengths of the investment and wax pattern materials as well as the roughness and shrinkage patterns of the molten alloy. Dr. John P. Nielsen of J. F. Jelenko and Co., Inc., indicated that although the precious metal alloys now used in dentistry are highly successful, most have been developed empirically over a period of many years. He suggested that basic studies of the metallurgy of these alloys, with particular emphasis on minor constituents, can lead not only to improved properties but also to reduced precious metal content and thus reduced costs for dental care.

A session covering new developments in nonmetallic

restorative materials included discussions on dental porcelain, silicate cement, composite restorative materials, and EBA cements, as well as the problem of adhesion of cements to tooth structure. Dr. John W. McLean, Eastman Dental Hospital, London, reviewed several aspects of current research on dental porcelains—increasing fracture resistance of poreclain restorations by fusing porcelain to metals, dispersion strengthening of the dental porcelain with alumina crystals, and bonding of dental porcelain to high strength recrystallized alumina. After reviewing recent work on the formation and structure of dental silicate cement, Mr. Alan D. Wilson, Laboratory of the Government Chemist, London, concluded that the faults of this widely used material are inherent and that future research for an improved translucent cement will have to be along radically different lines. The recent rapid development of silica-resin composite restorative materials was discussed by Dr. R. L. Bowen, ADA Research Division, NBS. He indicated that present research on these materials directed toward improving properties and improving bonding to tooth structure will eventually provide better restorations for anterior teeth.

Dr. G. M. Brauer, NBS, spoke on EBA cements, which are formed by the reaction of zinc oxide with *o*-ethoxybenzoic acid and which retain the excellent tissue compatibility of zinc oxide-eugenol materials. Recent improvements in the EBA cements, such as reinforcement with aluminum oxide particles, and present research promise to make them particularly suitable for use as bases under restorations and possibly for semipermanent restorations.

Dr. Harvey Alter, Gillette Research Institute, speaking on the problem of adhesion between tooth structure and restorative material, predicted that in the future a polyurethane adhesive will be used, perhaps applied to an etched tooth surface treated with a silane coupling agent. The restoration itself might then be a polyurethane or some other material, such as acrylic resin.

A session on mechanical properties emphasized the need for research methods that provide a complete characterization of the stress and time dependence of the response of dental materials to mechanical forces. Mr. Philip L. Oglesby, NBS, pointed out the necessity for viscoelastic methods to describe the mechanical behavior of dental amalgams, resins, composite restorative materials, and soft and hard oral tissues as well as to understand the response of these materials to various conventional flow, indentation, and stress-strain tests. Mr. Richard L. Myerson, Myerson Tooth Corp., described the utilization of low frequency mechanical properties as determined by the torsion pendulum for analyzing the molecular structures of materials, particularly polymeric and ceramic materials. Mr. George Dickson, NBS, described ultrasonic methods that can be used to determine the elastic characteristics of dental materials and mineralized tissues.

Reporting on recent advances in stress analysis of dental structures, Dr. Robert G. Craig, University of Michigan, indicated that because of the complex geometry of dental structures, theoretical methods have not so far proved to be as effective as experimental procedures that use brittle coating strain gages and transmission and reflection photoelasticity. The problem of relating mechanical properties to clinical performance of dental materials was discussed by Dr. David B. Mahler, University of Oregon, who showed that rheological behavior of amalgam can be correlated with marginal fracture in clinical service.

The development of improved methods for evaluating dental materials was considered in detail by several speakers. Dr. H. P. L. Schoenmakers, Tandheelkundig Instituut Rijksuniversiteit, The Netherlands, brought out the need for careful analysis of the nature of fracture, or other failure, of materials in the mouth and for development of test methods related to the specific properties involved. Dr. Björn Hedegård, Odontologiska Kliniken Tandlakarhogskolan, Sweden, pointed out that the relation of physical properties to clinical service requires more reliable methods for evaluating clinical service. Dr. Gunnar Ryge, Division of Dental Health, Public Health Service, followed with a discussion of procedures being developed and utilized for the quantitative evaluation of clinical dental restorations by means of specific classification and rating scales and "calibrated" observers. Quantitative measurement of corrosion of alloys in the mouth was described by Dr. Kazuo Nagai, Nihon University, Tokyo.

A session on international and national specification programs was introduced by Mr. Alan R. Docking, Commonwealth Bureau of Dental Standards, Australia, who cited the NBS and ADA work as a solid foundation for developing specifications throughout the world. Dr. Pierre Laplaud, L'École de Chirugie Dentaire et de Stomatologie de Paris, France, called for establishing more international specifications and increased coordination of national specifications to eliminate nonessential differences between requirements in different countries. Dr. Léo Werner Süffert, Universidade Federal do Rio Grande do Sul, Brazil, spoke on the development of a specification program in conjunction with rapid developments in dental service and in the manufacture of dental materials.

A review of the dental specification program in the United States concluded the Symposium. Dr. John W. Stanford, ADA, indicated that future progress will be facilitated by the recent incorporation of the program into the American National Standards Institute and by participation in the International Organization for Standardization.

The proceedings of the Symposium will be published by NBS and made available by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

SCHEDULED NBS-SPONSORED CONFERENCES

Each year NBS sponsors a number of conferences covering a broad range of topics in science and technology. The

conferences listed below are either sponsored or cosponsored by NBS and will be held at the Bureau's Gaithersburg, Md., facility unless otherwise indicated. These conferences are open to all interested persons unless specifically noted. If no other address is given, inquiries should be sent to the person indicated below in care of Special Activities Section, Room A600, Administration Building, National Bureau of Standards, Washington, D.C. 20234.

Twelfth Scintillation and Semiconductor Counter Symposium. Mar. 11–13. Cosponsors: IEEE (Nuclear Science Group); Atomic Energy Commission. Contact: Louis Costrell (NBS Center for Radiation Research).

Performance of Masonry Structures. Mar. 16–18. Cosponsors: National Concrete Masonry Association; Structural Clay Products Institute. Contact: Robert Dikkers (NBS Building Research Division).

Second IEEE Transducer Conference. May 4–5. Sponsor: IEEE (Group on Industrial Electronics and Controlled Instrumentation). Contact: Paul Lederer (NBS Electronic Technology Division).

Operations Research—Users and Producers. May 7–8. Cosponsors: Institute of Management Sciences; Operations Research Society of America; Washington Operations Research Council, Contact: Lloyd Burden (NBS Technical Analysis Division).

Silicon Device Processing. June 2–3. Cosponsor: American Society for Testing and Materials (Committee F–1). Contact: C. P. Marsden (NBS Electronic Technology Division).

1970 Conference on Precision Electromagnetic Measurements. June 2–5. Cosponsors: IEEE (Group on Instrumentation and Measurement); International Scientific Radio Union (U.S. Commission 1). Contact: George Goulette, Bureau of Continuation Education, University of Colorado, Boulder, Colo. 80302. To be held at NBS in Boulder, Colo.

1970 Standards Laboratory Conference, Innovative Metrology—Key to Progress. June 15–17. Sponsor: National Conference of Standards Laboratories. Contact: H. L. Mason (NBS Institute for Basic Standards).

55th National Conference on Weights and Measures. July 12–17. Contact: Ross Koeser (NBS Office of Weights and Measures). To be held at the Hotel Utah, Salt Lake City, Utah.

International Conference on Precision Measurement and Fundamental Constants. Aug. 3–7. Cosponsors: IUPAC; CODATA; National Academy of Sciences-National Research Council; International Bureau of Weights and Measures. Contact: E. Ambler (NBS Institute for Basic Standards).

Space Simulation Conference. Sept. 14–16. Cosponsors: American Institute of Aeronautics and Astronautics; Institute of Environmental Sciences; American Society for Testing and Materials. Contact: J. C. Richmond (NBS Heat Division).

25th Calorimetry Conference. Oct. 19–22. Contact: E. Domalski (NBS Physical Chemistry Division).

The Science of Ceramic Machining and Surface Finishing. Nov. 2–4. Cosponsors: Office of Naval Research; American Ceramic Society. Contact: S. J. Schneider (NBS Inorganic Materials Division).

Symposium on the Application of Computers to Environmental Engineering Design. Nov. 30–Dec. 2. Cosponsor: American Society of Heating, Refrigerating and Air Conditioning Engineers. Contact: R. Achenbach (NBS Building Research Division).

STRUCTURAL PERFORMANCE OF A BUILDING SYSTEM

A key factor to real progress in overcoming the present severe housing shortage in the United States, particularly of low income housing, is the development of evaluative techniques that will serve as a basis for judging the structural adequacy of proposed innovative solutions.

Structural Performance of a Building System, by E. O. Pfrang and F. Y. Yokel, NBS Building Science Series 25,[1] summarizes the results of a comprehensive series of load tests on a full-scale portion of a proposed building system. The test structure, one story in height, was chosen and loaded in a way that simulated the structural response of the complete building subjected to dead, live, and wind loads. These results are supplemented by data from tests on components and materials used in the test structure. In addition to the evaluation of structural performance, the results allow significant conclusions to be drawn concerning structural interactions.

[1] Available from Superintendent of Documents, U.S. Government Printing Office, Wash., D.C. 20402, for $1.25. Order by SD Catalog No. C13.29/2:25.

PUBLICATIONS of the National Bureau of Standards*

PERIODICALS

Technical News Bulletin, Volume 54, No. 1, January 1970, 30 cents. Annual subscription: Domestic, $3; foreign, $4. Available on a 1-, 2-, or 3-year subscription basis.

Journal of Research of the National Bureau of Standards

Section A. Physics and Chemistry. Issued six times a year. Annual subscription: Domestic, $9.50; foreign, $11.75. Single copy price varies.

Section B. Mathematical Sciences. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25.

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